

Project Report: Investigation of the composition of comet 2P/Encke at infrared wavelengths

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### Project Progress

*Comet 2P/Encke*. M. Mumma, M. DiSanti, N. Dello Russo, B. Bonev, K. Magee-Sauer, and E. Gibb investigated the composition of comet 2P/Encke at infrared wavelengths. Six nights of observing time was awarded at the NASA Infrared Telescope Facility and the W.M. Keck Observatory in November, 2003, for this Jupiter-family comet of probable Kuiper-belt origin. Long-slit spectra from the facility instruments CSHELL (Infrared Telescope Facility (IRTF)) and NIRSPEC (Keck) featured both high spectral dispersion and high spatial resolution about the nucleus.  $\text{H}_2\text{O}$ ,  $\text{C}_2\text{H}_6$ ,  $\text{CH}_3\text{OH}$ ,  $\text{HCN}$ , and  $\text{C}_2\text{H}_2$  were detected (the symmetric hydrocarbons for the first time in Encke), and production rates and rotational temperatures were determined. Rotational analysis of  $\text{H}_2\text{O}$  and  $\text{C}_2\text{H}_6$  suggested very cold rotational distributions for coma gases ( $T_{\text{rot}} \sim 20 - 30\text{K}$ ). Relative abundances for  $\text{C}_2\text{H}_6$ ,  $\text{CH}_3\text{OH}$ ,  $\text{HCN}$ , and  $\text{C}_2\text{H}_2$  with respect to water were close to those typically seen in Oort cloud comets, while the abundance of hypervolatile  $\text{CH}_4$  was severely depleted. This represents the most detailed study of a comet of probable Kuiper-belt origin with high-resolution ground-based infrared spectroscopy, and serves as a model for future studies of faint comets.

### Highlights

- High dispersion spectra of Comet 2P/Encke were obtained at high spatial resolution about the nucleus; the rotational temperature of coma gases was between 25 and 30K, methane was severely depleted while the relative abundances of ethane, methanol, hydrogen cyanide, and acetylene were normal.

### Roadmap Objectives

- **Objective No. 3.1: Sources of prebiotic materials and catalysts**